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IS 7014 (1973): Length Bars [PGD 25: Engineering Metrology]

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(First Reprint MARCH 1999) REAFFIRMED
(Incorporating Amendment No. 1) 2004

IS : 7014 - 1973
(Reaffirmed 1995)

Indian Standard

SPECIFICATION FOR LENGTH BARS

1. Scope — Covers the requirements of length bars of the cylindrical type in sizes up to 1 200 mm, having parallel end faces finished by lapping. Two designs of length bars have been provided, one with plane end faces and the other with annular faces surrounding an internally threaded hole at one end or at both ends of the bar.

2. Terminology

2.1 *Airy Positions* — The airy positions (*see* Fig. 1) are those points at which a bar of uniform cross section shall be supported, when used with its axis horizontal, to bring the end faces of the bar parallel; when it is so supported, the flexure of the bar under its own weight is reduced almost to a minimum.

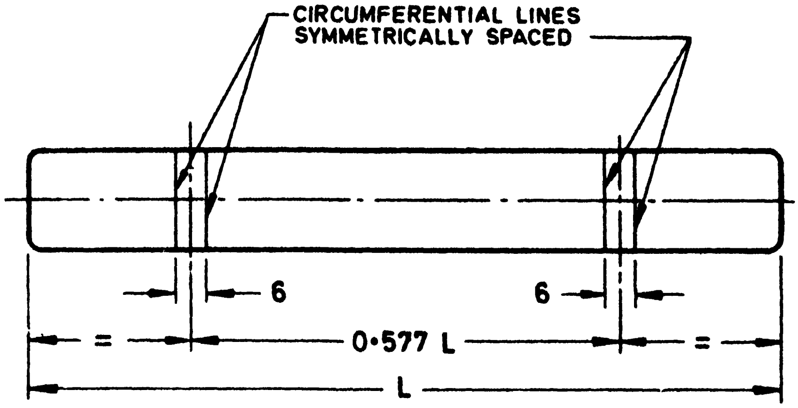


FIG. 1 INDICATION OF AIRY POSITIONS

2.2 *Flatness* — The maximum permissible distance between two imaginary parallel planes within which the contour of a face can just be enclosed (*see* Fig. 2).

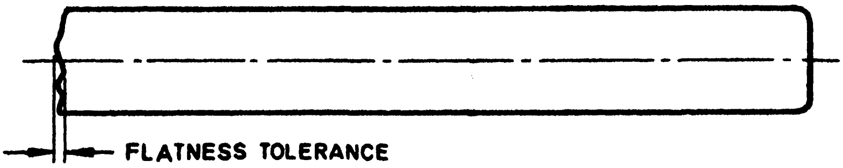
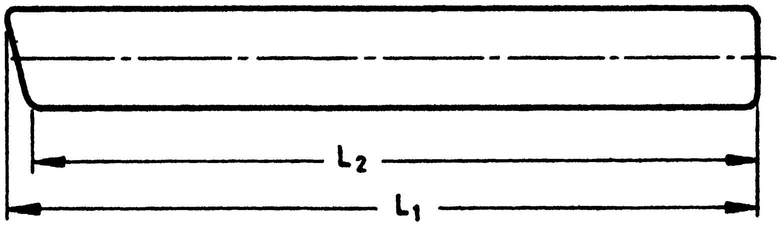


FIG. 2 EXAGGERATED ILLUSTRATION OF FLATNESS TOLERANCE

2.3 *Parallelism* — Parallelism refers to the maximum variation in the length of any one bar (*see* Fig. 3).



PARALLELISM TOLERANCE = $l_1 - l_2$

FIG. 3 EXAGGERATED ILLUSTRATION OF PARALLELISM TOLERANCE

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Engineering Metrology Sectional Committee, EDC 43; Gauges Subcommittee, EDC 43 : 8 [Ref : Doc : EDC 43 (2056)]

2.4 *Squareness* — The maximum permissible distance between two imaginary parallel planes normal to the axis of the airy positions and just enclosing the face under consideration (*see* Fig. 4).

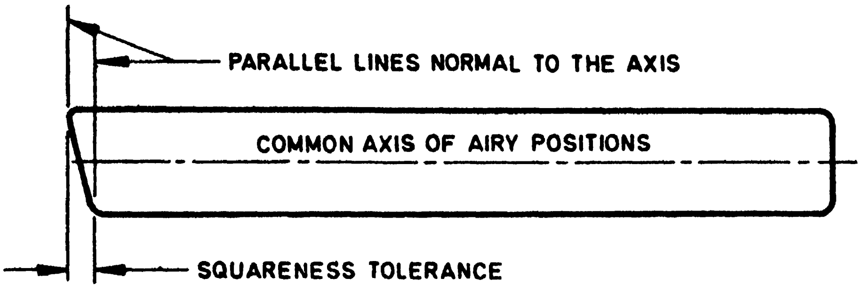
PARALLEL LINES NORMAL TO THE AXIS
COMMON AXIS OF AIRY POSITIONS
SQUARENESS TOLERANCE

FIG. 4 EXAGGERATED ILLUSTRATION OF SQUARENESS TOLERANCE

3. Material and Finish

3.1 The bars shall be made of high quality tool steel, free from non-metallic inclusions.

3.2 The 25 mm bars shall be hardened throughout their length.

3.3 Bars over 25 mm and up to and including 125 mm shall be hardened throughout their length or at the ends only for a distance of not less than 4 mm.

3.4 Longer bars shall be hardened for a distance of about 6 mm but not less than 4 mm from each end.

3.5 The bars shall be stabilized after hardening by a suitable stabilizing process.

3.6 The hardness of the end faces of the finished bars shall be 750 *HV Min* [*see* IS : 1501-1968 Method for Vickers hardness test for steel (*first revision*)].

3.7 The body of each bar shall be finished all over by fine grinding.

3.8 The end faces of the bars shall be lapped to provide a finish of the highest quality both for appearance and for wringing property. They shall be free from scratches and blemishes of any noticeable character. The edges shall be radiused as shown in Fig. 5 and 6.

3.9 Threaded holes and screws, when provided, shall be cleanly finished and all sharp edges shall be removed.

4. **Grades** — Length bars shall be of four grades of accuracy, namely, reference, calibration, inspection and workshop.

4.1 *Reference Grade* — Reference grade bars, as their name implies, are intended for use as reference standards. They have completely plane faces and embody the highest order of accuracy as regards both their end faces and the finishing of their, actual lengths to their nominal sizes.

4.2 *Calibration Grade* — Calibration grade bars possess the same degree of perfection in their completely plane end faces as the reference grade bars. They differ only in the somewhat wider tolerances allowed in the adjustment of their lengths to the nominal sizes, which thus permits them to be produced more economically than reference grade bars.

4.3 *Inspection Grade** — Inspection grade bars have internally threaded ends and can thus be used in combination with each other. They are intended for use in inspection rooms and tool rooms.

4.4 *Workshop Grade** — Workshop grade bars also have internally threaded ends and can be used with slip gauges, comparators and their own accessories for measuring gauges, jigs, work pieces, etc. They are intended for use in workshops.

5. Form and General Dimensions

5.1 *Reference Grade and Calibration Grade Bars*

5.1.1 Reference grade and calibration grade bars shall be cylindrical in form and shall have plane end faces.

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*For recommended sets of inspection and workshop grade of length bars, see Appendix A.

AMENDMENT NO. 1 JUNE 1977
TO
IS:7014-1973 SPECIFICATION FOR LENGTH BARS

Alterations

(Page 4, clause 8.2):

a) *Line* 1 - Substitute '6H' *for* 'H6'.

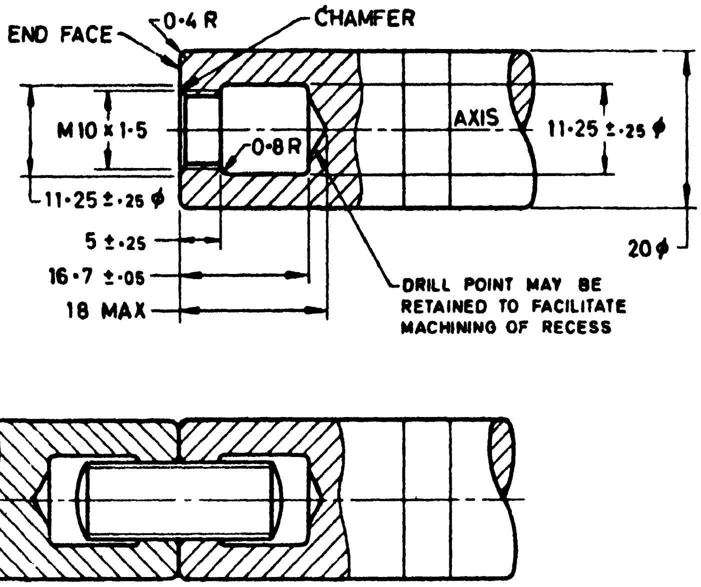
b) *Line* 2 - Substitute '5g/6g' *for* 'g5/g6'.

(EDC 43)

Reprography Unit, ISI, New Delhi

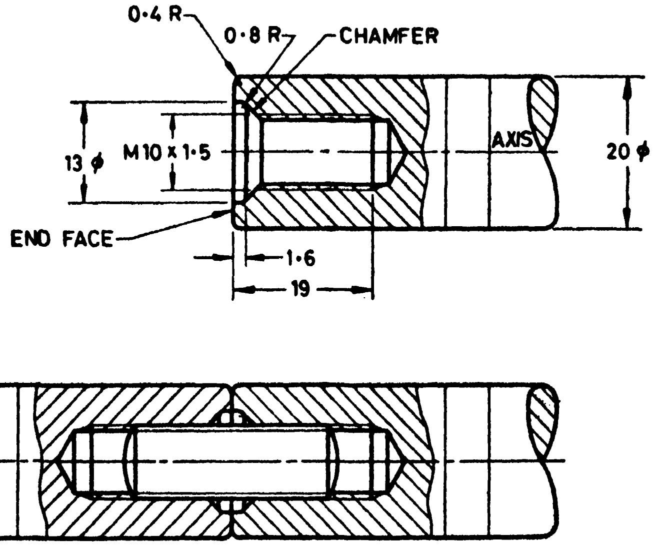
5.1.2 The ' airy positions ' on all bars having length of 150 mm and above shall be indicated by two symmetrically spaced pairs of bold circumferential lines scribed around the bars (*see* Fig. 1). The lines shall not stand proud of the surface of the bar.

5.2 *Inspection Grade and Workshop Grade Bars* — Inspection grade and workshop grade bars shall be cylindrical in form, 20 mm in diameter, and internally threaded and recessed at one or both ends. It may be convenient on occasions to supply the 25 mm bar solid throughout. The airy positions on all bars 150 mm in length and over shall be indicated as for reference grade and calibration grade bars (*see* Fig. 5 and 6).



All dimensions in millimetres.

FIG. 5 INSPECTION GRADE LENGTH BAR



All dimensions in millimetres.

FIG. 6 WORKSHOP GRADE LENGTH BAR

The thread connections at the end of inspection bars shall be made in accordance with the dimensions and tolerances specified in Fig. 5. Those at the ends of workshop bars shall preferably be made in accordance with the dimensions and tolerances specified in Fig. 6; alternatively, they may also be made to the dimensions and tolerances given in Fig. 5.

All threaded connections shall be assembled hand-tight only.

6. Designation — The length bars shall be designated by their nominal size, grade and the number of this standard.

Example:

A length bar of nominal size 200 mm and of workshop grade shall be designated as:

Length Bar 200 Workshop IS : 7014

7. Accuracy

7.1 *Diameter* — The diameter of each bar shall be uniform within 0·013 mm for bars up to 300 mm in length, 0·025 mm for bars over 300 mm and up to 600 mm in length, and within 0·050 mm for bars longer than 600 mm.

7.2 *Straightness* — The body shall be straight to within 0·002 5 mm per 25 mm of length.

7.3 *End Faces*

7.3.1 *Flatness and parallelism* — The tolerances on flatness and parallelism of end faces shall be as given in Tables 1 to 4.

7.3.2 *Squareness* — The end faces of all grades of bars shall be square with the common axis of the airy positions to within 0·001 3 mm over the diameter of the face, for bars up to and including 400 mm in length and to within 0·002 5 mm for bars over 400 mm in length.

7.4 *Length* — The tolerances on length shall be as given in Tables 1 to 4.

8. Connecting Screws for Inspection Grade and Workshop Grade Bars

8.1 At least six unhardened connecting screws M10 × 1·5 of precision grade shall be provided with each set of inspection grade or workshop grade bars for holding them together. They shall screw quite freely into the threaded holes in the bars and shall not prevent the wringing faces from coming into satisfactory contact.

8.2 Suitable tolerances for the type of fit required are 6H for the holes made in the length bars and 5g/6g for the connecting screws.

9. Marking

9.1 Each bar shall have legibly and permanently marked upon it the following particulars:

a) Nominal size;

b) An identification number;

c) Grade, that is, reference, calibration, inspection or workshop; and

d) Manufacturer's name or trade-mark.

9.2 *Certification Marking* — Details available with the Bureau of Indian Standards.

10. Packing — Each set of length bars shall be housed in one or more dustproof cases, having a separate compartment for each bar. Provision shall be made for easy removal of the bars from the case. When the lid of the case is closed and fastened, each bar shall be held firmly in its seating.

11. Protection Against Climatic Conditions — All surfaces of the bars shall be protected against climatic conditions by being covered with a suitable corrosion preventive preparation.

Table 1 DIMENSIONS FOR LENGTH BARS OF REFERENCE GRADE

(*Clauses* 7.3.1 *and* 7.4)

All dimensions in millimetres.

Nominal Size *L*	Tolerance on Accuracy of Faces*		Tolerance on Length at 20°C
	Flatness	Parallelism	
25	0·000 1	0·000 1	± 0·000 08
50	0·000 1	0·000 1	± 0·000 10
75	0·000 1	0·000 2	± 0·000 15
100	0·000 1	0·000 2	± 0·000 20
125	0·000 15	0·000 25	± 0·000 25
150	0·000 15	0·000 25	± 0·000 30
175	0·000 15	0·000 25	± 0·000 35
200	0·000 15	0·000 25	± 0·000 40
225	0·000 15	0·000 25	± 0·000 45
250	0·000 15	0·000 25	± 0·000 50
275	0·000 15	0·000 25	± 0·000 55
300	0·000 15	0·000 25	± 0·000 6
400	0·000 15	0·000 25	± 0·000 8
500	0·000 15	0·000 25	± 0·001 0
600	0·000 15	0·000 25	± 0·001 2
700	0·000 15	0·000 25	± 0·001 4
800	0·000 15	0·000 25	± 0·001 6
900	0·000 15	0·000 25	± 0·001 8
1 000	0·000 15	0·000 25	± 0·002 0
1 200	0·000 15	0·000 25	± 0·002 4

Note — Bars of intermediate sizes should be made to the same tolerances as those for the next smaller size.

*For tolerances on squareness, *see* 7.3.2.

TABLE 2 DIMENSIONS FOR LENGTH BARS OF CALIBRATION GRADE

(*Clauses* 7.3.1 *and* 7.4)

All dimensions in millimetres.

Nominal Size *L*	Tolerance on Accuracy of Faces*		Tolerance on Length at 20°C
	Flatness	Parallelism	
25	0·000 1	0·000 1	± 0·000 15
50	0·000 1	0·000 1	± 0·000 25
75	0·000 1	0·000 2	± 0·000 40
100	0·000 1	0·000 2	± 0·000 50
125	0·000 15	0·000 25	± 0·000 65
150	0·000 15	0·000 25	± 0·000 75
175	0·000 15	0·000 25	± 0·000 9
200	0·000 15	0·000 25	± 0·001 0
225	0·000 15	0·000 25	± 0·001 1
250	0·000 15	0·000 25	± 0·001 2
275	0·000 15	0·000 25	± 0·001 4
300	0·000 15	0·000 25	± 0·001 5
400	0·000 15	0·000 25	± 0·002 0
500	0·000 15	0·000 25	± 0·002 5
600	0·000 15	0·000 25	± 0·003 0
700	0·000 15	0·000 25	± 0·003 5
800	0·000 15	0·000 25	± 0·004 0
900	0·000 15	0·000 25	± 0·004 5
1 000	0·000 15	0·000 25	± 0·005
1 200	0·000 15	0·000 25	± 0·006

Note — Bars of intermediate sizes should be made to the same tolerances as those for the next smaller size.

*For tolerances on squareness, *see* 7.3.2.

TABLE 3 DIMENSIONS FOR LENGTH BARS OF INSPECTION GRADE

(*Clauses* 7.3.1 *and* 7.4)

All dimensions in millimetres.

Nominal Size* *L*	Tolerance on Accuracy of Faces†		Tolerance on Length at 20°C
	Flatness	Parallelism	
25	0·000 15	0·000 15	+ 0·000 18 − 0·000 18
50	0·000 15	0·000 15	+ 0·000 35 − 0·000 18
75	0·000 2	0·000 20	+ 0·000 5 − 0·000 2
100	0·000 2	0·000 20	+ 0·000 7 − 0·000 3
125	0·000 2	0·000 25	+ 0·000 9 − 0·000 4
150	0·000 2	0·000 25	+ 0·001 0 − 0·000 4
175	0·000 2	0·000 25	+ 0·001 2 − 0·000 5
200	0·000 2	0·000 25	+ 0·001 4 − 0·000 6
375	0·000 2	0·000 50	+ 0·002 6 − 0·001 1
(400)	0·000 2	0·000 50	+ 0·002 8 − 0·001 2
575	0·000 2	0·000 50	+ 0·004 0 − 0·001 7
(600)	0·000 2	0·000 50	+ 0·004 2 − 0·001 8
775	0·000 2	0·000 50	+ 0·005 4 − 0·002 3
(800)	0·000 2	0·000 50	+ 0·005 6 − 0·002 4
(1 000)	0·000 2	0·000 50	+ 0·007 0 − 0·003 0
(1 200)	0·000 2	0·000 50	+ 0·008 4 − 0·003 6

Note — Bars of intermediate sizes should be made to the same tolerances as those for the next smaller size.

*For an explanation of this selection of sizes, see Appendix A where details of recommended sets of inspection and workshop bars are given; sizes in brackets are non-preferred.

†For tolerances on squareness, *see* 7.3.2.

TABLE 4 DIMENSIONS FOR LENGTH BARS OF WORKSHOP GRADE

(*Clauses* 7.3.1 *and* 7.4)

All dimensions in millimetres.

Nominal Size* *L*	Tolerances on Accuracy of Faces†		Tolerance on Length at 20°C
	Flatness	Parallelism	
25	0·000 20	0·000 25	+ 0·000 3 − 0·000 3
50	0·000 20	0·000 25	+ 0·000 5 − 0·000 3
75	0·000 25	0·000 4	+ 0·000 8 − 0·000 4
100	0·000 25	0·000 4	+ 0·001 0 − 0·000 5
125	0·000 25	0·000 4	+ 0·001 3 − 0·000 7
150	0·000 25	0·000 4	+ 0·001 5 − 0·000 8
175	0·000 25	0·000 4	+ 0·001 8 − 0·000 9
200	0·000 25	0·000 4	+ 0·002 − 0·001
375	0·000 25	0·000 5	+ 0·004 − 0·002
(400)	0·000 25	0·000 5	+ 0·004 − 0·002
575	0·000 25	0·000 6	+ 0·006 − 0·003
(600)	0·000 25	0·000 6	+ 0·006 − 0·003
775	0·000 25	0·000 6	+ 0·008 − 0·004
(800)	0·000 25	0·000 6	+ 0·008 − 0·004
(1 000)	0·000 25	0·000 8	+ 0·010 − 0·005
(1 200)	0·000 25	0·000 8	+ 0·012 − 0·006

Note — Bars of intermediate sizes should be made to the same tolerances as those for the next smaller size.

*For an explanation of this selection of sizes, see Appendix A where details of recommended sets of inspection and workshop bars are given; sizes in brackets are non-preferred.

†For tolerances on squareness, *see* 7.3.2.

APPENDIX A

(*Clauses* 4.3 *and* 4.4)

RECOMMENDED SETS OF INSPECTION AND WORKSHOP GRADES OF LENGTH BARS

A-1. Inspection and workshop grades of length bars are designed to be used either singly or in combination. By using the bars in combination the number of bars in a set required to cover a particular range of sizes may be reduced and so result in considerable economies. This explains the selection of the particular series of nominal sizes given in Tables 3 and 4.

A-2. The refined screwed connection makes it possible to use inspection grade bars in combination without any appreciable loss of the overall accuracy associated with this grade.

A-3. The original screwed connection is quite satisfactory for use in combination bars required for workshop accuracy.

A-4. The following recommended sets of bars are given as a guide to purchasers. Inspection sets are given in Table 5 and workshop sets in Table 6. Alternative sets employing different combinations and numbers of bars can, of course, be worked out.

TABLE 5 DIMENSIONS FOR INSPECTION GRADE BARS (14 BARS)

Length	Type of Bar
25	Solid at both ends
25	Screwed at one end only
25	
50	
75	
100	
125	
150	
175	
200	
200	Screwed at both ends
375	
575	
775	

Note — With the set of 14 bars listed above, the following composite bars, increasing in length by 25 mm increments in the following size ranges, may be built up, each combination having solid end faces:

Range 25 mm to 375 mm (using not more than 2 bars per combination).
„ 400 mm to 1 150 mm („ „ „ „ 3 „ „ „).
„ 1 175 mm to 1 725 mm („ „ „ „ 4 „ „ „).

TABLE 6 DIMENSIONS FOR WORKSHOP GRADE BARS (11 BARS)

Length	Type of Bar
25	Screwed at both ends
50	
75	
100	
125	
150	
175	
200	
375	
575	
775	

Note — With the set of 11 bars listed above, the following composite bars, increasing in length by 25 mm increments in the following size ranges, may be built up:

Range 25 mm to 975 mm (using not more than 2 bars per combination).
„ 1 000 mm to 1 550 mm („ „ „ „ 3 „ „ „).

EXPLANATORY NOTE

Length bars are used for the calibration of comparator type instruments, for measuring jigs, workpieces, etc, and in wide variety of set up work in inspection and in the workshop.

Length bar was originally devised by Brookes of National Physical Laboratory, UK, in 1920 initially with the intention of having a means of transferring from line to end standards of length. They have, however, come into much wider use in the intervening years as a means of establishing size accurately for lengths longer than that practically produced using the slip gauge combination.

When used in the horizontal position, the end bars are supported at the Airy positions, so that their end faces become parallel and the measurement of their sizes may be accurate. When the bars are used in combination, the Airy positions for the overall length of the combination are calculated. Accessories for use with length bars are being covered in a separate standard.

This standard is based on BS 1790 : 1961 'Specification for length bars and their accessories' issued by the British Standards Institution.

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